

Dungeness Pot Survey and Spatial Monitoring of Sea Otter Bycatch in Ugak Bay, the Trinity Islands, and Alitak Bay in the Kodiak Area, 2014

by

Carrie Worton

and

Philip Tschersich

August 2014

Alaska Department of Fish and Game

Divisions of Sport Fish and Commercial Fisheries



Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in the following reports by the Divisions of Sport Fish and of Commercial Fisheries: Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

Weights and measures (metric)		General		Mathematics, statistics		
centimeter	cm	Alaska Administrative Code	AAC	all standard mathematical signs, symbols and abbreviations		
deciliter	dL	all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.	alternate hypothesis	H _A	
gram	g	all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.	base of natural logarithm	<i>e</i>	
hectare	ha			catch per unit effort	CPUE	
kilogram	kg	at	@	coefficient of variation	CV	
kilometer	km			common test statistics	(F, t, χ^2 , etc.)	
liter	L	compass directions:		confidence interval	CI	
meter	m	east	E	correlation coefficient (multiple)	R	
milliliter	mL	north	N	correlation coefficient (simple)	r	
millimeter	mm	south	S	covariance	cov	
Weights and measures (English)		west	W	degree (angular)	°	
	cubic feet per second	ft³/s	copyright	©	degrees of freedom	df
	foot	ft	corporate suffixes:		expected value	<i>E</i>
	gallon	gal	Company	Co.	greater than	>
	inch	in	Corporation	Corp.	greater than or equal to	≥
	mile	mi	Incorporated	Inc.	harvest per unit effort	HPUE
	nautical mile	nmi	Limited	Ltd.	less than	<
	ounce	oz	District of Columbia	D.C.	less than or equal to	≤
	pound	lb	et alii (and others)	et al.	logarithm (natural)	ln
	quart	qt	et cetera (and so forth)	etc.	logarithm (base 10)	log
yard	yd	exempli gratia		logarithm (specify base)	log ₂ , etc.	
Time and temperature		(for example)	e.g.	minute (angular)	'	
	day	d	Federal Information Code	FIC	not significant	NS
	degrees Celsius	°C	id est (that is)	i.e.	null hypothesis	H ₀
	degrees Fahrenheit	°F	latitude or longitude	lat. or long.	percent	%
	degrees kelvin	K	monetary symbols		probability	P
	hour	h	(U.S.)	\$, ¢	probability of a type I error	
	minute	min	months (tables and figures): first three		(rejection of the null hypothesis when true)	α
	second	s	letters	Jan,...,Dec	probability of a type II error	
	Physics and chemistry		registered trademark	®	(acceptance of the null hypothesis when false)	β
		all atomic symbols		trademark	™	second (angular)
alternating current		AC	United States		standard deviation	SD
ampere		A	(adjective)	U.S.	standard error	SE
calorie		cal	United States of America (noun)	USA	variance	
direct current		DC	U.S.C.	United States Code	population sample	Var var
hertz		Hz	U.S. state	use two-letter abbreviations		
horsepower		hp		(e.g., AK, WA)		
hydrogen ion activity (negative log of)		pH				
parts per million		ppm				
parts per thousand	ppt, ‰					
volts	V					
watts	W					

REGIONAL OPERATIONAL PLAN CF.4K.2014.25

**DUNGENESS POT SURVEY AND SPATIAL MONITORING OF SEA
OTTER BYCATCH IN UGAK BAY, THE TRINITY ISLANDS, AND
ALITAK BAY IN THE KODIAK AREA, 2014**

by

Carrie Worton

Alaska Department of Fish and Game, Division of Commercial Fisheries, Kodiak

and

Philip Tschersich

Alaska Department of Fish and Game, Division of Commercial Fisheries, Kodiak

Alaska Department of Fish and Game
Division of Commercial Fisheries

August 2014

The Regional Operational Plan Series was established in 2012 to archive and provide public access to operational plans for fisheries projects of the Divisions of Commercial Fisheries and Sport Fish, as per joint-divisional Operational Planning Policy. Documents in this series are planning documents that may contain raw data, preliminary data analyses and results, and describe operational aspects of fisheries projects that may not actually be implemented. All documents in this series are subject to a technical review process and receive varying degrees of regional, divisional, and biometric approval, but do not generally receive editorial review. Results from the implementation of the operational plan described in this series may be subsequently finalized and published in a different department reporting series or in the formal literature. Please contact the author if you have any questions regarding the information provided in this plan. Regional Operational Plans are available on the Internet at: <http://www.adfg.alaska.gov/sf/publications/>

*Carrie Worton,
and
Philip Tschersich
Alaska Department of Fish and Game, Division of Commercial Fisheries,
351 Research Court, Kodiak, AK 99615, USA*

This document should be cited as:

Worton, C., and P. Tschersich. 2014. Dungeness pot survey and spatial monitoring of sea otter bycatch in Ugak Bay, the Trinity Islands, and Alitak Bay in the Kodiak Area, 2014. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Operational Plan ROP.CF.4K.2014.25, Kodiak.

The Alaska Department of Fish and Game (ADF&G) administers all programs and activities free from discrimination based on race, color, national origin, age, sex, religion, marital status, pregnancy, parenthood, or disability. The department administers all programs and activities in compliance with Title VI of the Civil Rights Act of 1964, Section 504 of the Rehabilitation Act of 1973, Title II of the Americans with Disabilities Act (ADA) of 1990, the Age Discrimination Act of 1975, and Title IX of the Education Amendments of 1972.

If you believe you have been discriminated against in any program, activity, or facility please write:

ADF&G ADA Coordinator, P.O. Box 115526, Juneau, AK 99811-5526

U.S. Fish and Wildlife Service, 4401 N. Fairfax Drive, MS 2042, Arlington, VA 22203

Office of Equal Opportunity, U.S. Department of the Interior, 1849 C Street NW MS 5230, Washington DC 20240

The department's ADA Coordinator can be reached via phone at the following numbers:

(VOICE) 907-465-6077, (Statewide Telecommunication Device for the Deaf) 1-800-478-3648,

(Juneau TDD) 907-465-3646, or (FAX) 907-465-6078

For information on alternative formats and questions on this publication, please contact:

ADF&G, Division of Sport Fish, Research and Technical Services, 333 Raspberry Rd, Anchorage AK 99518 (907) 267-2375

SIGNATURE/TITLE PAGE

Project Title: Dungeness Pot Survey and Spatial Monitoring of Sea Otter Bycatch in Ugak Bay, the Trinity Islands, and Alitak Bay in the Kodiak Area, 2014

Project Leader(s): *Carrie Worton, Fishery Biologist III*

Division, Region and Area: Division of Commercial Fisheries, Region IV, Kodiak

Project Nomenclature:

Period Covered: August 1, 2014–August 31, 2016

Field Dates: August 5–September 26, 2014

Plan Type: Category II

Approval

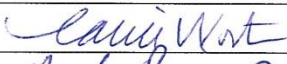
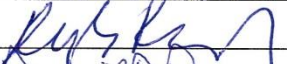

Title	Name	Signature	Date
Project Leader	Carrie Worton		8/1/14
Section Supervisor	Doug Pengilly		4 Aug '14
Biometrician	Dave Barnard		4 Aug 2014

TABLE OF CONTENTS

	Page
LIST OF TABLES.....	iv
LIST OF FIGURES	iv
LIST OF APPENDICES	iv
ABSTRACT	1
PURPOSE.....	1
BACKGROUND	1
OBJECTIVES.....	2
METHODS.....	2
Survey Design	2
Pot Survey	3
Trawl	3
Catch Sampling	4
Tagging.....	4
Sea Otter Survey	4
Temperature and Salinity Data Collection.....	5
Tag Recovery.....	5
Data Analysis.....	5
SCHEDULE AND DELIVERABLES	7
RESPONSIBILITIES	7
ACKNOWLEDGEMENT	7
REFERENCES CITED	8
TABLES	9
FIGURES	13
APPENDIX A. SURVEY SCHEDULE.....	19
APPENDIX B. DUNGENESS SURVEY FORMS.....	23
APPENDIX C. SAMPLING AND TAGGING PROCEDURES	31
APPENDIX D. SEA OTTER SURVEY FORM AND PROCEDURES	37

LIST OF TABLES

Table	Page
1. Start locations for each transect by survey area and sampling location.	10
2. Historic pot lifts from 1992 to 2013 Dungeness fishery and calculated catch per unit effort of sea otters based on the potential biological rate (PBR).	11
3. Expected sea otter catch and probabilities of sea otter capture in 300 pot lifts for a range of true sea otter CPUE.	12

LIST OF FIGURES

Figure	Page
1. Map depicting project survey areas in Ugak Bay, Alitak Bay, and the Trinity Islands in the Kodiak Management Area.	14
2. Map showing a visual representation of 5 transects (thin black lines) with 10 pots (yellow circles) deployed in 5 m isobath intervals (blue stepped gradient) per transect, along with three trawl tows (thick black lines) following isobaths.	15
3. Map showing six sampling locations for Dungeness crab pot surveys in Ugak Bay (stat area 525701) with proposed pot transects shown (black lines) and 5 m isobath intervals shown (blue stepped gradient).	16
4. Map showing six sampling locations for Dungeness crab pot surveys around Tugidak and Sitkinak islands with proposed pot transects shown (black lines), stat area 545601 (red line), and 5 m isobath intervals shown (blue stepped gradient).	17
5. Map showing four sampling locations for Dungeness crab pot surveys around lower Alitak Bay with proposed pot transects shown (black lines), stat area 545632, and 5 m isobath intervals shown (blue stepped gradient).	18

LIST OF APPENDICES

Appendix	Page
A1. August 2014 project survey schedule showing activities distinguished by color with fishing pots = Group A in yellow, Group B in orange; travel days = green; sea otter survey = blue; fishing trawl net = tan.	20
A2. September 2014 project survey schedule showing activities distinguished by color with fishing pots = Group A in yellow, Group B in orange; travel days = green; sea otter survey = blue; fishing trawl net = tan.	21
B1. Pot Survey Pilot House Log Form.	24
B2. Skipper Trawl Record Form.	26
B3. ADF&G Crab Data Form.	28
C1. Dungeness crab carapace width measurement.	32
C2. Dungeness crab shell age determination.	33
C3. Dungeness crab clutch fullness.	34
C4. Dungeness crab tag location.	35
D1. Sea otter observation form.	38
D2. Sea otter behavior and sex determination.	40

ABSTRACT

This report describes the project operational plan for a Dungeness crab *Metacarcinus magister* pot survey and the spatial monitoring of sea otter *Enhydra lutris kenyoni* bycatch in the Kodiak Area of the Westward Region. Descriptions of objectives, survey plan, methods, and data analysis are outlined. The Dungeness pot survey will be conducted by the Alaska Department of Fish and Game (ADF&G) aboard the R/V *K-Hi-C* in three areas important for the Kodiak Area commercial Dungeness fishery: Ugak Bay, the Trinity Islands, and Alitak Bay. Dungeness crabs will be enumerated and biological data from Dungeness crabs as well as any bycatch of sea otters will be recorded. A sea otter survey will be conducted to determine presence of sea otters in the area during the pot survey for Dungeness crabs and any gear interactions will be recorded. Additional projects to be conducted during the survey will include using a small trawl net to supplement abundance data information of Dungeness crabs, tagging of Dungeness crabs to determine movements and growth increments, and ancillary data on temperature and salinity conditions in the area will be recorded. This information will be incorporated into future stock assessments of Dungeness crabs and sea otters in the Kodiak Area.

Key words: Dungeness crab, *Metacarcinus magister*, northern sea otter, *Enhydra lutris kenyoni*, pot, bycatch, Ugak Bay, Trinity Islands, Alitak Bay, Kodiak, Alaska

PURPOSE

In a collaborative effort between the Alaska Department of Fish and Game (ADF&G) and the U.S. Fish and Wildlife Service (USFWS), we will conduct Dungeness crab *Metacarcinus magister* pot surveys on the east side and south side of Kodiak Island using an ADF&G research vessel to document Dungeness crab presence and sea otter bycatch in Dungeness pots. The goal is to assess Dungeness crab population distribution and abundance and concurrently determine the extent of sea otter bycatch and interactions with Dungeness crab pot gear. A Dungeness crab survey will supply baseline information about Dungeness crab stocks in important areas fished around Kodiak Island. This survey will also serve as a platform for a cooperative sea otter study with USFWS. In 2005, the USFWS listed the Southwest Alaska distinct population segment (SW Alaska DPS) of northern sea otter *Enhydra lutris kenyoni*, which includes the sea otters occupying the Kodiak Archipelago, as threatened under the 1973 Endangered Species Act (USFWS, 2013a). The stable or increasing abundance of sea otters in the Kodiak Area increases potential for fishery bycatch and gear interactions with commercial Dungeness crab pots. As there currently is no observer program that can quantify bycatch of this marine mammal species, sea otter presence, interactions, and bycatch will be documented during the survey to provide information to the USFWS for sea otter stock assessment.

BACKGROUND

Dungeness crab have been commercially harvested in the Kodiak Area since 1962. The fishery is managed by the Alaska Department of Fish and Game with restrictions only on the fishery season dates, size, and sex (Sagalkin and Spalinger, 2011). The Kodiak Area fishery is open from May 1 through December 30 except for the south end of Kodiak Island, which is open from June 15 through December 30 (5AAC 32.410). Three statistical areas, 525701 (Ugak Bay), 545601 (the Trinity Islands), and 545632 (Alitak Bay), together accounted for 70% of the historic commercial Dungeness crab harvest in the Kodiak Area (Figure 1). Little information is available on the current condition of the Dungeness stocks in the Kodiak Area, as the last

Dungeness crab survey was done in 1986 (Hicks, 1987), and a project for providing data on the distribution, sex and size composition, movement, growth, and female reproductive condition of Kodiak Area Dungeness crab has been identified as an ADF&G Westward Region priority for funding since 2001 (ADF&G 2001, 2014). This survey will also serve as a platform for a cooperative study of sea otters with USFWS to collect information on the Southwest Alaska stock of sea otters. The Southwest Alaska stock of sea otters includes animals from the Alaska Peninsula and Bristol Bay coasts, and the Aleutian, Pribilof, Barren, and Kodiak Islands. The Recovery Plan for the Southwest Alaska sea otter stock cites incomplete information regarding the level and incidence of bycatch in directed fisheries, but it is known that shallow-water pot fisheries have potential to entrap otters (USFWS, 2013b). Hatfield *et al.* (2011) documented sea otters as being caught and drowned in fishing pots and traps. Moreover, bycatch mortality of listed California sea otters was a contributing factor in the population decline from the mid-1970s through the early 1980s (Estes *et al.*, 2003).

As sea otter populations continue to recolonize the Kodiak area, concerns over the potential of sea otter interactions with fishing gear during the Dungeness crab fishery have increased. With no observer program, bycatch data used for stock assessment reporting is incomplete. Anecdotal information suggests that sea otter bycatch in the Dungeness crab fishery has occurred in the Kodiak Area, but there is little information regarding the level and incidence. Our approach will be to conduct a Dungeness crab pot survey in areas of historically high fishing effort and collect data on distribution, relative abundance, catch per unit effort (CPUE), size, sex, shell condition, reproductive condition, movements, and growth of Dungeness crab and concurrently monitor sea otter bycatch, spatial distribution, behavior, and interactions with fishing gear during the survey.

OBJECTIVES

We propose to gather data on Dungeness crab and on the potential for sea otter bycatch in the Dungeness crab fishery by conducting a survey using commercial Dungeness pots in three important Dungeness crab fishing areas around Kodiak Island. We will also gather data on spatial distribution of sea otters in the study area as well as behavioral observations and fishing gear interactions. The objectives are:

- 1) Obtain data on distribution, relative stock abundance, CPUE, size, and sex composition, shell condition, and reproductive status of Dungeness crab in Ugak Bay (statistical area 525701), the Trinity Islands (statistical area 545601) and Alitak Bay (statistical area 545632).
- 2) Document sea otter bycatch during the survey and estimate the catch per pot lift of sea otters in the surveyed areas.
- 3) Document sea otter presence, abundance, sex composition, behavior, and interactions with Dungeness pot gear by conducting observations in each survey area.
- 4) Determine Dungeness crab movements and growth increments through tagging male Dungeness crabs during the survey and recovering tagged crabs in the commercial fishery.

METHODS

SURVEY DESIGN

The 39-day pot survey will be conducted aboard the ADF&G R/V *K-Hi-C* between August 5 and September 30, 2014, in Ugak Bay, the Trinity Islands, and Alitak Bay in the Kodiak Area (Figure 1). The survey areas are located inside state waters between 56°15' to 58°30' N latitude

and 155°00' to 152°10' W longitude, within statistical areas 525701, 545601, and 545632. Specific bays within each study area will be systematically sampled (Table 1). The gear used will consist of commercial Dungeness crab pots and a small bottom trawl sampling net.

POT SURVEY

In each of the 3 survey areas, 6 sampling locations will be identified and systematically fished using 100 commercial Dungeness crab pots. The 6 sampling locations, designated by bay or landmark, are known areas of Dungeness habitat. The pots will be divided into 2 groups of 50 pots: Group A and Group B. The deployment and retrieval of Groups A and B will occur on different days, so that only 50 pots will be lifted on any given day within the main survey area. The 50 pots within each sampling location will be soaked for a 72-hour period before they are retrieved, rebaited, and redeployed. A total of 300 pot lifts will be completed for each of the main survey areas. See Appendices A1 and A2 for a calendar timeline of survey effort.

Within each sampling location, the 50 pots will be set along 5 evenly-spaced transects perpendicular to the beach at the head of the bay. The distribution of the 5 transects will span the width of the head of the bay (Figures 2 through 7). Each individual transect will consist of a 10 pots strings set at approximately 5 m depth intervals between a minimum depth of 5 m depth to a maximum depth of 50 m. For analysis, these pots will be classified into three depth strata (5-20 m, 21-35 m, 36-50 m) adjusted to mean lower low water (MLLW; http://tidesandcurrents.noaa.gov/datum_options.html). Placement of pots may be adjusted based on the bathymetry, shape of the shoreline, or obstacles (e.g., other Dungeness fishing gear in the area), but the distance between pots will be a minimum of 200 m to minimize gear interaction. Each stainless steel mesh pot used in the survey will measure 38.5 in (98 cm) in diameter and 12 in (30 cm) in height and will conform to the definition for legal Dungeness crab pots (5 AAC 32.050 (b)) and to requirements for escape mechanisms (5 AAC 39.145 (1) and for gear marking (5 AAC 32.051) by having 2 tunnels with tunnel-eye openings measuring 4 in (10 cm) in height and 8 in (20 cm) in width, 2 circular 4³/₈ in (11 cm) inside-diameter escape rings on the upper half of the vertical plane of the pot on opposing sides of the pot, the pot lid tie-down straps secured by a loop of untreated, biodegradable, 60 thread 100% cotton twine, and an individually-numbered pot buoy tag. Tunnel eyes on each pot will be fitted with a trigger device to keep crabs in the pot. For the purposes of retaining under-sized crab during the survey, half of the pots will have their escape rings closed off with zip-ties. In order to randomly distribute pots with open and closed escape rings within each survey location, each of the 1-50 pots will be pre-assigned a random order of deployment using a random number generator. Each pot will be assigned a sequential pot number (SPN) when deployed that will run consecutively from the start of the survey (SPN 1) to the end of the survey (SPN 900). SPN, bay or general location, buoy ID number, date, time, and depth (m), latitude, and longitude will be recorded during deployment and retrieval of each pot on the Pot Survey Pilot House Log Form (Appendix B1).

TRAWL

To better assess relative abundance and distribution, a small trawl net will be used to sample Dungeness crabs within each survey area. The net measures 4.9 m long with 4.5 m footrope, 2-6.8 kg trawl doors, and net body and cod-end composed of 3.0 cm mesh. It has proven to be a useful gear type for catching Dungeness crabs of all sizes including smaller crabs that are less

likely to go into a crab pot (Worton *et al.*, 2010). Trawling will occur only after pot fishing has been completed (Appendix A1). Three starting locations will be randomly selected from the 50 pot locations within each bay or location. A random number generator will be used to select 3 numbers out of 50 which correspond to 3 of the 50 pot locations previously fished. These locations will be the starting locations of the 3 trawl tows within each location. The net will be towed for approximately 0.5 nmi (1.85 km) following a depth isobath. A hypothetical example of trawl track locations in a bay is depicted in Figure 2. A total of 54 trawl hauls will be completed during this study. Location, heading, trawling start/stop time, depth, scope, gear performance, and weather conditions will be recorded on the Skipper Trawl Record Form (Appendix B2).

CATCH SAMPLING

All the catch in the Dungeness crab pots and trawl hauls will be enumerated by species and biological data will be recorded from each Dungeness crab. The pot data will provide CPUE for Dungeness crabs and sea otter bycatch, while the trawl data will be used to determine an area swept estimate of abundance of Dungeness crabs. All Dungeness crabs will be measured to the nearest 0.1 mm, shell aged, and sex and reproductive status determined and recorded on the ADF&G Crab Data Form (Appendix B3). Carapace width (CW) of Dungeness crabs will be taken from the greatest width across the carapace, not including the antiolateral spines (Appendix C1). The legal (≥ 165 mm) and sublegal (< 165 mm) status will be recorded. Shell age will be determined through visual inspection of the carapace as seen in Appendix C2. Clutch fullness of mature female Dungeness crabs will be determined by examining the percent of clutch fullness relative to the abdominal flap as described in Appendix C3. Embryo development will be noted by the presence or absence of eyed eggs, and clutch condition will be recorded as the proportional amount of dead eggs present or condition of the setae on the pleopods. Other commercially important crabs such as Tanner crabs *Chionoecetes bairdi* and red king crab *Paralithodes camtschaticus* will also be enumerated and measured. Tanner crab CW will be measured to the nearest mm across the carapace at the widest part perpendicular to the medial line, inside the lateral spines (Jadamec *et al.*, 1999). Red king crab will be measured for carapace length to the nearest mm from the posterior margin of the right eye orbit to the midpoint of the anterior margin of the carapace (Wallace *et al.*, 1949).

TAGGING

Sublegal male Dungeness crab ≥ 130 mm CW (the approximate size at one molt from legal size; Worton *et al.* 2010) and legal (≥ 165 mm CW) male Dungeness crab determined to be in good condition will be tagged at the posterior margin of the epimeral suture immediately posterior to the third walking leg on the right hand side of the carapace using a Floy double T-bar anchor tag (FD-94; Appendix C4). All crab meeting those criteria, or a random subsample thereof, will be tagged up to a goal of 1,000 tagged crab per survey area. Tagged Dungeness crab will be measured for CW to the nearest 0.1 mm and shell condition, tag number and general condition after tagging will be recorded on the ADF&G Crab Data Sampling Form (Appendix B3) prior to returning the crab to the capture location.

SEA OTTER SURVEY

A dedicated vessel-based sea otter survey will be conducted in each survey area, approximately every seven days, to document the presence of sea otters. Total number, group sizes (e.g., “1 group of 20, 1 group of 25, and 3 single otters”), sex, and behavior of sea otters will be recorded,

as will the number of sea otters in the vicinity of the survey Dungeness pot gear and any sea otter interactions with the gear. A brief description of sea otter social activity and sex determination is provided in Appendix D2. Any human disturbance of sea otters during the observations and any injuries or mortalities will be noted. Record all information on the Sea Otter Observation Form (Appendix D1). Any sea otters captured in the pots or tangled in fishing gear and recovered alive will be released as quickly as possible. Prior to release, the sex and size of the animal will be estimated. Any sea otter mortalities will be retained and frozen for later necropsy by the USFWS. Extreme caution will be taken when handling a live sea otter to avoid injury to the animal and crew.

TEMPERATURE AND SALINITY DATA COLLECTION

Surface temperature (°C) and salinity (ppt) will be recorded at each pot survey sampling location approximately 1 m below the surface. An Onset HOBO™ temperature datalogger will be used to record bottom temperature at each pot survey location. A temperature datalogger will be deployed in the 1st and 50th pot within each sampling location and be programmed to record temperatures every hour. During trawling, a datalogger will be attached to the headrope of the net during each deployment and temperature will be recorded every minute. The datalogger ID number will be recorded on the Pot Survey Pilot House Log Form when deployed in a pot (Appendix B1), or on the Skipper Trawl Record Form when deployed on the trawl net (Appendix B2).

TAG RECOVERY

Through the ADF&G dockside sampling program, efforts will be made to recover tagged crab during the 2014/2015 Dungeness fishery by posting flyers at the ADF&G office and at the fishery processor plants. Fisherman will be asked to record the location, depth, and date of capture for any tagged crab. Tagged legal crab will be retained by the fisherman for measuring and shell aging by dockside sampling staff. Tagged sublegal crab will be measured and shell aged by the fisherman and returned to sea.

DATA ANALYSIS

CPUE for Dungeness crabs and sea otters will be summarized by sex, size, depth stratum for each survey area. The CPUE, defined as the mean catch per number of pot lift, will be determined for the survey where c_i is the total number of Dungeness crabs (or sea otters) captured in pots, n is the number of pot lifts for the survey area,

$$CPUE = \frac{1}{n} \sum_{i=1}^n c_i = \bar{c}, \quad (1)$$

and the standard error (SE) of the CPUE is

$$SE(CPUE) = \sqrt{\frac{\sum_{i=1}^n (c_i - \bar{c})^2}{n(n-1)}}. \quad (2)$$

Sea otter bycatch and observations will be summarized by survey area, sex, and age group. An estimate of sea otters bycatch B in the fishery will be determined by multiplying CPUE determined from the survey by the total number of pot lifts N during the fishery,

$$B = CPUE * N. \quad (3)$$

Size frequency, shell condition, and reproductive condition of Dungeness crabs will be summarized by survey area and depth stratum. An ANOVA will be used to test the effects of depth stratum and open/closed escape rings on the crab catch by sex and size.

Based on the assumption that Dungeness crabs are evenly distributed within the survey areas and the trawled areas are randomly distributed with respect to the crab population, the relative population abundance from the trawl catch will be determined using the area-swept method (Alverson and Pereyra, 1969), where

$$C_{li} = \text{catch/km for tow } i \text{ in area } l$$

then the mean catch rate for area l is

$$\bar{C}_l = \frac{1}{n_l} \sum_{i=1}^{n_l} C_{li} \quad (4)$$

where n_l = number of tows in area l , and the variance for the mean catch in area l is

$$Var \bar{C}_l = \frac{1}{n_l - 1} \sum_{i=1}^{n_l} (C_{li} - \bar{C}_l)^2 \quad (5)$$

then expanding catch/km to abundance, for area l abundance P_l is

$$\hat{P}_l = \frac{A_l}{a_l} \bar{C}_l \quad (6)$$

where, A_l = area of area l and a_l = area swept by the trawl in area l .

Then the population abundance is

$$\hat{P} = \sum_{l=1}^h \hat{P}_l = \sum_{l=1}^h \frac{A_l}{a_l} \bar{C}_l \quad (7)$$

where h = the number of areas, and

$$Var \hat{P} = \sum_{l=1}^h \frac{A_l^2}{a_l^2} Var \bar{C}_l \quad (8)$$

Tag recovery data from the 2014 and 2015 season will be summarized by release and capture location, release and recovery dates, and mapped for determination of spatial and temporal movement patterns. Minimum distances and direction of travel between release and recovery sites will be determined. Growth increments will be determined and summarized for each tagged crab recovered. A simple linear regression model will be used to describe the dependence of the postmolt CW size on the premolt CW size. The linear model

$$y = \beta_0 + \beta_1 x, \quad (9)$$

where x is the premolt CW, y is the postmolt CW, and β_0 and β_1 are estimated parameters, will be fitted by least squares regression. These results will be compared to growth data collected during a tagging study conducted in Kodiak from 1970 to 1974 (Worton *et al.*, 2010).

The ability to detect potential for sea otter bycatch and the precision of the estimated sea otter bycatch rate (CPUE) in each surveyed area that is afforded by our study design can be evaluated by using the bycatch rate (CPUE) that would be needed to reach the potential biological removal rate (PBR; Wade and Angliss, 1997) during the commercial Dungeness fishery as a benchmark. The PBR specified for the Southwest Alaska stock of sea otters is 450 sea otters per year (USFWS, 2013a). Given the historic annual fishery effort (number of pot lifts) during the 1992–

2013 Kodiak Area Dungeness crab fishery seasons, the true sea otter CPUE needed to reach the PBR of 450 sea otters ranges between 0.002 and 0.023, depending on season, and averages 0.0203 for the last 2 years (Table 2). Under the assumptions that the 300 pot lifts within each surveyed area are independent with respect to the sea otter catch and the catch of sea otters in the 300 pot lifts has a Poisson distribution, there is a 90% chance of capturing at least one sea otter in 300 pot lifts when the true CPUE is ≥ 0.008 (Table 3). The precision of the sea otter CPUE estimates and expected sea otter catch and the probabilities of sea otter capture in 300 pot lifts for a range of true sea otter CPUE are listed in Table 3.

SCHEDULE AND DELIVERABLES

<u>Date</u>	<u>Activity</u>
August 5-16	Survey of Ugak Bay
August 17-29	Survey of the Trinity Islands
September 14-26	Survey of Alitak Bay
October 2014-August 2015	Data entry, analysis, and report writing and review
September, 2015	Interim grant report to USFWS
November, 2015	Final grant report to USFWS

RESPONSIBILITIES

Fishery Biologist III, Carrie Worton project principal investigator responsible for management of the project, project logistics, operational plan, data analysis, and final report.

Fishery Biologist II, Philip Tschersich responsible for conducting the field portion of the project, and assisting with operational plan and logistics.

Fishery Biologist I, Rob Baer responsible for conducting the field portion of the project and project logistics.

Boat Officer III, Kurt Pedersen responsible for operating the ADF&G R/V K-Hi-C.

ACKNOWLEDGEMENT

We would like to thank Verena Gill, Marine Mammal Manager for the USFWS for specifying the handling of sea otters, data collection, and methods developed for conducting the sea otter observations, and disposition of any sea otters captured during the survey.

REFERENCES CITED

- ADF&G (Alaska Department of Fish and Game). 2001. A program for improving management and research of fisheries in the Westward Region – Groundfish and miscellaneous shellfish fisheries: Project Bluebook –2001. Alaska Department of Fish and Game, Division of Commercial Fisheries, Westward Region, Kodiak, October 2001.
- ADF&G (Alaska Department of Fish and Game). 2014. A program for improving management and research of fisheries in the Westward Region: Project Bluebook –2001. Alaska Department of Fish and Game, Division of Commercial Fisheries, Westward Region, Kodiak, January 2014.
- Alverson, D. L., and W. T. Pereyra. 1969. Demersal fish explorations in the northeastern Pacific Ocean. An evaluation of exploratory fishing methods and analytical approaches to stock size and yield forecasts. Journal of the fisheries research board of Canada 26: 1985-2001.
- Estes, J. A., B. B. Hatfield, K. Ralls, and J. Ames. 2003. Causes of mortality in California sea otters during periods of population growth and decline. Marine Mammal Science 19: 198-216.
- Hatfield, B. B., J. A. Ames, J. A. Estes, M. T. Tinker, A. B. Johnson, M. M. Staedler, and M. D. Harris. 2011. Sea otter mortality in fish and shellfish traps: estimating potential impacts and exploring possible solutions. Endangered Species Research 13.
- Hicks, D. 1987. King/Dungeness crab survey, Kodiak, Alaska. Alaska Department of Fish and Game Technical Data Report No. 204. Alaska Department of Fish and Game, Juneau, Alaska.
- Jadamec, L. S., W. E. Donaldson, and P. Cullenberg. 1999. Biological field techniques for *Chionoecetes* crabs. University of Alaska Sea Grant. AK-SG-99-02, Fairbanks.
- Sagalkin, N. H., and K. Spalinger. 2011. Annual management report for shellfish fisheries in the Kodiak, Chignik, and Alaska Peninsula Areas, 2010. Alaska Department of Fish and Game, Fishery Management Report No. 11-43, Anchorage.
- USFWS (United States Fish and Wildlife Service). 2013a. Northern sea otter (*Enhydra lutris kenyoni*): Southwest Alaska Stock Assessment. <http://www.fws.gov/alaska/fisheries/mmm/seaotters/reports.htm>.
- USFWS (United States Fish and Wildlife Service). 2013b. Southwest Alaska Distinct Population Segment of the Northern Sea Otter (*Enhydra lutris kenyoni*) - Recovery Plan. U.S. Fish and Wildlife Service, Region 7, Alaska. 171pp.
- Wade, P. R., and R. Angliss. 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop, April 3-5, 1996, Seattle Washington, U.S. Department of Commerce, National Oceanic and Atmospheric Administration. Technical Memorandum NMFS-OPR-12.
- Wallace, M. M., C. J. Pertuit, and A. R. Hvatum. 1949. Contribution of biology of king crab (*Paralithodes camtschatica*) Tilesius. U.S. Department of the Interior, Fish and Wildlife Service, Fishery Leaflet No. 340.
- Worton, C. L., D. Urban, K. M. Swiney, Z. Grauvogel, and S. Byersdorfer. 2010. Size at physiological maturity and minimum size at functional maturity for male Dungeness crabs in Alaska waters. In: (eds.) G.H. Kruse, G. L. Eckert, R. J. Foy, R. N. Lipcius, B. Sainte-Marie, D. L. Stram, D. Woodby. Biology and management of exploited crab populations under climate change. Alaska Sea Grant Program, University of Alaska Fairbanks, Fairbanks, pp. 319-340.

TABLES

Table 1.–Start locations for each transect by survey area and sampling location.

Ugak Bay												
Transect	Hidden Basin		Saltery Cove		Portage Bay (Ugak)		Pashagshak Bay		Eagle Harbor		Gull Point	
	N Latitude	W Longitude	N Latitude	W Longitude	N Latitude	W Longitude	N Latitude	W Longitude	N Latitude	W Longitude	N Latitude	W Longitude
1	57.509	152.956	57.507	152.767	57.476	152.623	57.458	152.452	57.418	152.712	57.334	152.639
2	57.511	152.953	57.504	152.756	57.475	152.618	57.461	152.460	57.421	152.715	57.340	152.633
3	57.514	152.949	57.501	152.745	57.474	152.612	57.464	152.468	57.423	152.719	57.345	152.627
4	57.517	152.945	57.498	152.734	57.474	152.607	57.466	152.476	57.426	152.722	57.351	152.621
5	57.519	152.942	57.495	152.723	57.473	152.601	57.468	152.484	57.428	152.725	57.356	152.615

Trinity Islands												
Transect	Tugidak Island T1		Tugidak Island T2		Tugidak Island T3		Sitkinak Island S1		Sitkinak Island S2		Sitkinak Island S3	
	N Latitude	W Longitude	N Latitude	W Longitude	N Latitude	W Longitude	N Latitude	W Longitude	N Latitude	W Longitude	N Latitude	W Longitude
1	56.392	154.735	56.447	154.657	56.484	154.563	56.478	154.445	56.478	154.325	56.478	154.232
2	56.400	154.712	56.457	154.640	56.489	154.545	56.478	154.422	56.478	154.307	56.478	154.217
3	56.413	154.696	56.464	154.624	56.494	154.533	56.478	154.396	56.478	154.289	56.478	154.200
4	56.426	154.682	56.472	154.604	56.495	154.517	56.478	154.373	56.478	154.271	56.478	154.183
5	56.438	154.670	56.478	154.582	56.500	154.501	56.478	154.349	56.478	154.253	56.478	154.166

Alitak Bay												
Transect	Alitak Flats A1		Alitak Flats A2		Alitak Flats A3		Alitak Flats A4		Alitak Flats A5		Kempff Bay	
	N Latitude	W Longitude	N Latitude	W Longitude	N Latitude	W Longitude	N Latitude	W Longitude	N Latitude	W Longitude	N Latitude	W Longitude
1	56.838	154.314	56.484	154.282	56.860	154.254	56.900	154.309	56.910	154.193	56.940	154.255
2	56.839	154.307	56.851	154.276	56.862	154.248	56.888	154.305	56.913	154.189	56.939	154.256
3	56.841	154.300	56.853	154.270	56.865	154.242	56.878	154.304	56.914	154.182	56.937	154.257
4	56.843	154.292	56.856	154.265	56.867	154.236	56.869	154.304	56.916	154.177	56.936	154.258
5	56.846	154.288	56.857	154.260	56.869	154.230	56.862	154.305	56.915	154.170	56.935	154.258

Table 2.–Historic pot lifts from 1992 to 2013 Dungeness fishery and calculated catch per unit effort of sea otters based on the potential biological rate (PBR).

Year	Total pot lifts in Dungeness fishery	Sea otter CPUE at PBR = 450
1992	220,076	0.0020
1993	180,534	0.0025
1994	151,888	0.0030
1995	107,506	0.0042
1996	88,682	0.0051
1997	95,066	0.0047
1998	63,926	0.0070
1999	65,721	0.0068
2000	57,037	0.0079
2001	41,760	0.0108
2002	71,096	0.0063
2003	48,715	0.0092
2004	42,990	0.0105
2005	38,422	0.0117
2006	31,670	0.0142
2007	65,071	0.0069
2008	93,414	0.0048
2009	129,003	0.0035
2010	101,341	0.0044
2011	60,248	0.0075
2012	24,645	0.0183
2013	19,597	0.0230
AVG 2012-2013	22,121	0.0203
AVG1992-2013	81,746	0.0055
AVG 2000-2013	58,929	0.0076
Max pot lifts	220,076	0.0020
Min pot lifts	19,597	0.0230

Table 3.–Expected sea otter catch and probabilities of sea otter capture in 300 pot lifts for a range of true sea otter CPUE.

Sea otter 'true' CPUE	Probability of catching at least 1 otter in 300 pot lifts	CPUE estimate from 300 pot lifts given 'true' CPUE			Sea otter catch in 300 pot lifts given 'true' CPUE		
		Expected	Lower 5%	Upper 95%	Expected	Lower 5%	Upper 95%
0.002	0.451	0.002	0.000	0.007	0.6	0	2
0.003	0.593	0.003	0.000	0.010	0.9	0	3
0.004	0.699	0.004	0.000	0.010	1.2	0	3
0.005	0.777	0.005	0.000	0.013	1.5	0	4
0.006	0.835	0.006	0.000	0.013	1.8	0	4
0.007	0.878	0.007	0.000	0.017	2.1	0	5
0.008	0.909	0.008	0.000	0.017	2.4	0	5
0.009	0.933	0.009	0.000	0.020	2.7	0	6
0.010	0.950	0.010	0.003	0.020	3.0	1	6
0.011	0.963	0.011	0.003	0.020	3.3	1	6
0.012	0.973	0.012	0.003	0.023	3.6	1	7
0.013	0.980	0.013	0.003	0.023	3.9	1	7
0.014	0.985	0.014	0.003	0.027	4.2	1	8
0.015	0.989	0.015	0.003	0.027	4.5	1	8
0.016	0.992	0.016	0.007	0.030	4.8	2	9
0.017	0.994	0.017	0.007	0.030	5.1	2	9
0.018	0.995	0.018	0.007	0.030	5.4	2	9
0.019	0.997	0.019	0.007	0.033	5.7	2	10
0.020	0.998	0.020	0.007	0.033	6.0	2	10
0.021	0.998	0.021	0.010	0.037	6.3	3	11
0.022	0.999	0.022	0.010	0.037	6.6	3	11
0.023	0.999	0.023	0.010	0.037	6.9	3	11

FIGURES

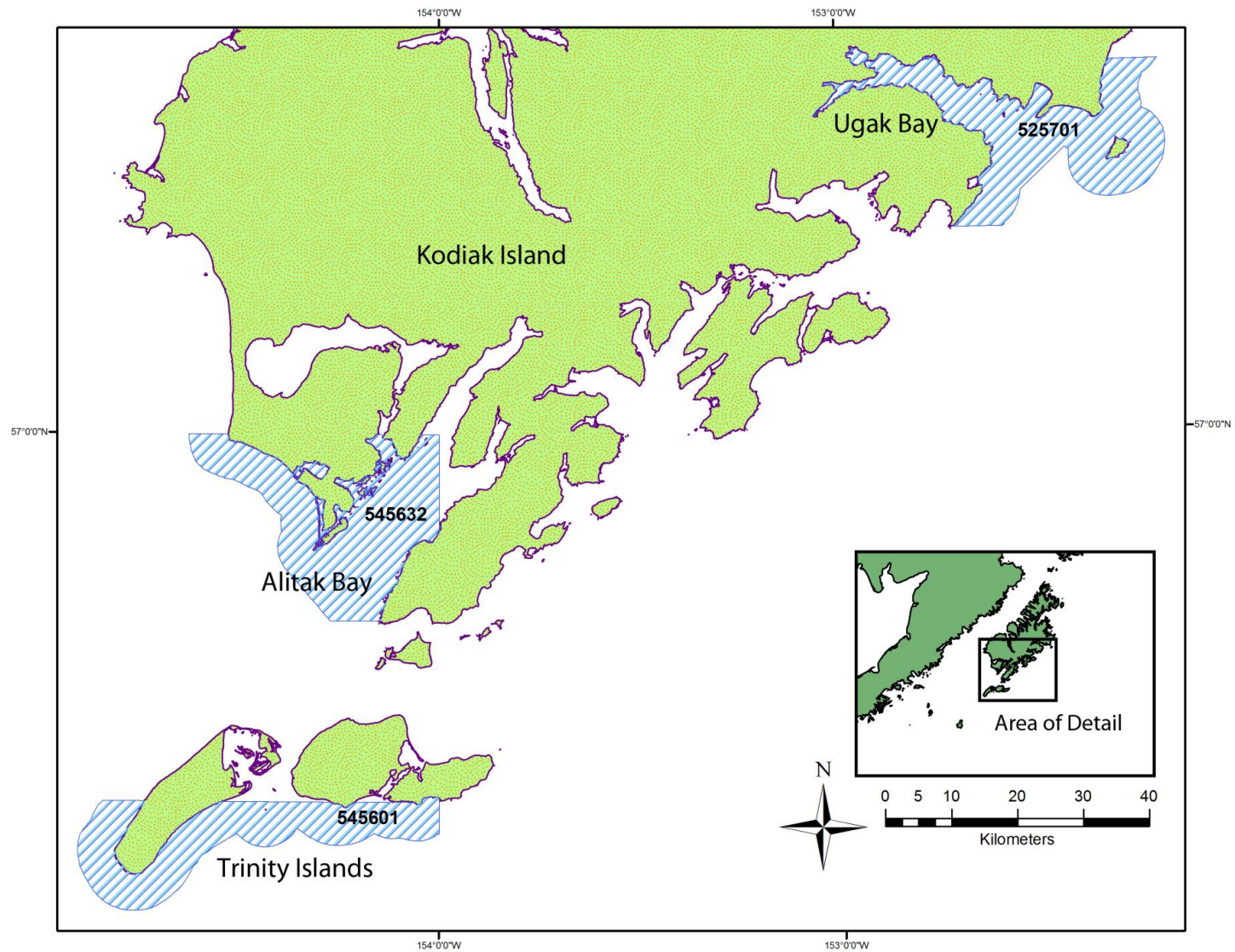


Figure 1.—Map depicting project survey areas in Ugak Bay, Alitak Bay, and the Trinity Islands in the Kodiak Management Area.

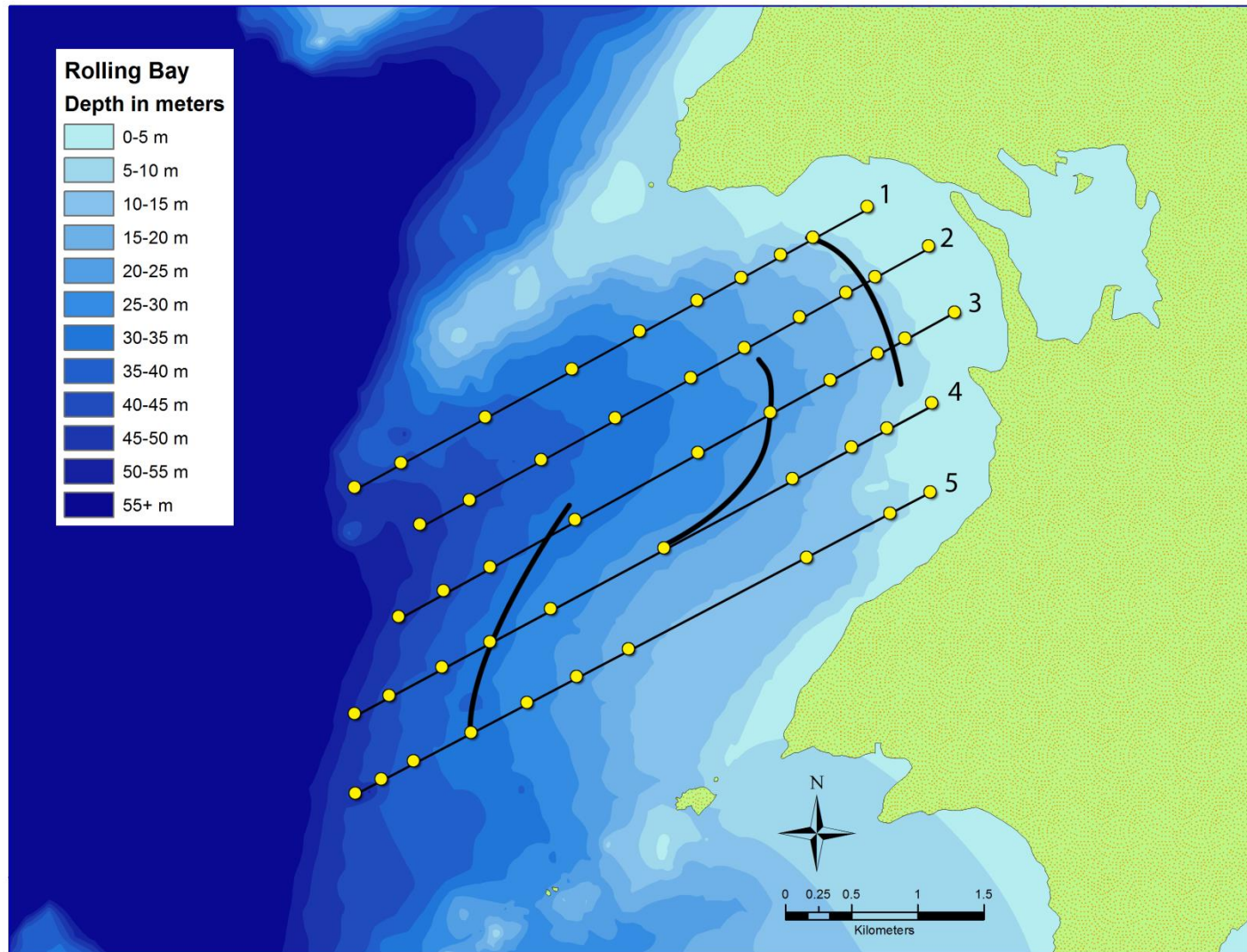


Figure 2.—Map showing a visual representation of 5 transects (thin black lines) with 10 pots (yellow circles) deployed in 5 m isobath intervals (blue stepped gradient) per transect, along with three trawl tows (thick black lines) following isobaths.

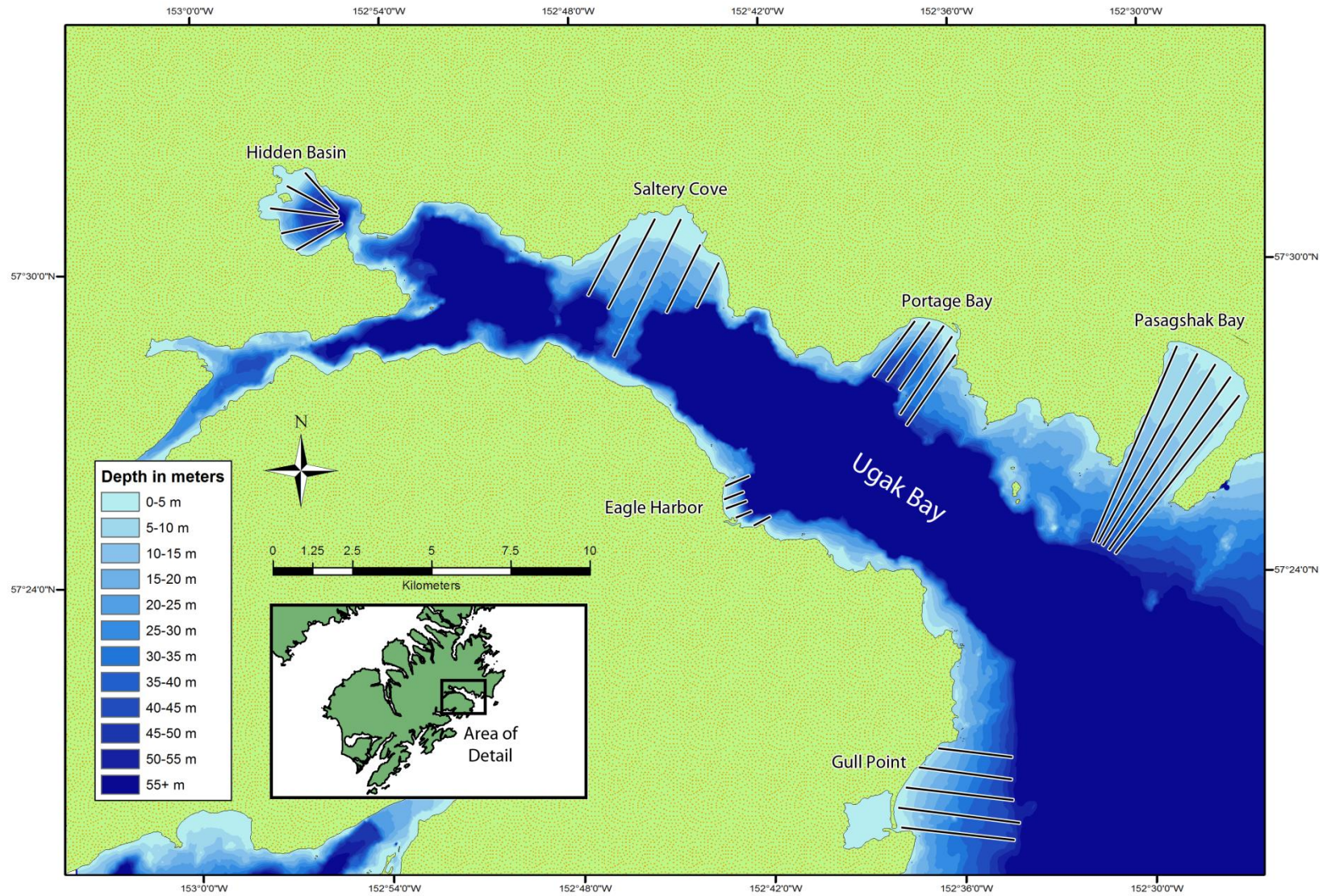


Figure 3.—Map showing six sampling locations for Dungeness crab pot surveys in Ugak Bay (stat area 525701) with proposed pot transects shown (black lines) and 5 m isobath intervals shown (blue stepped gradient).

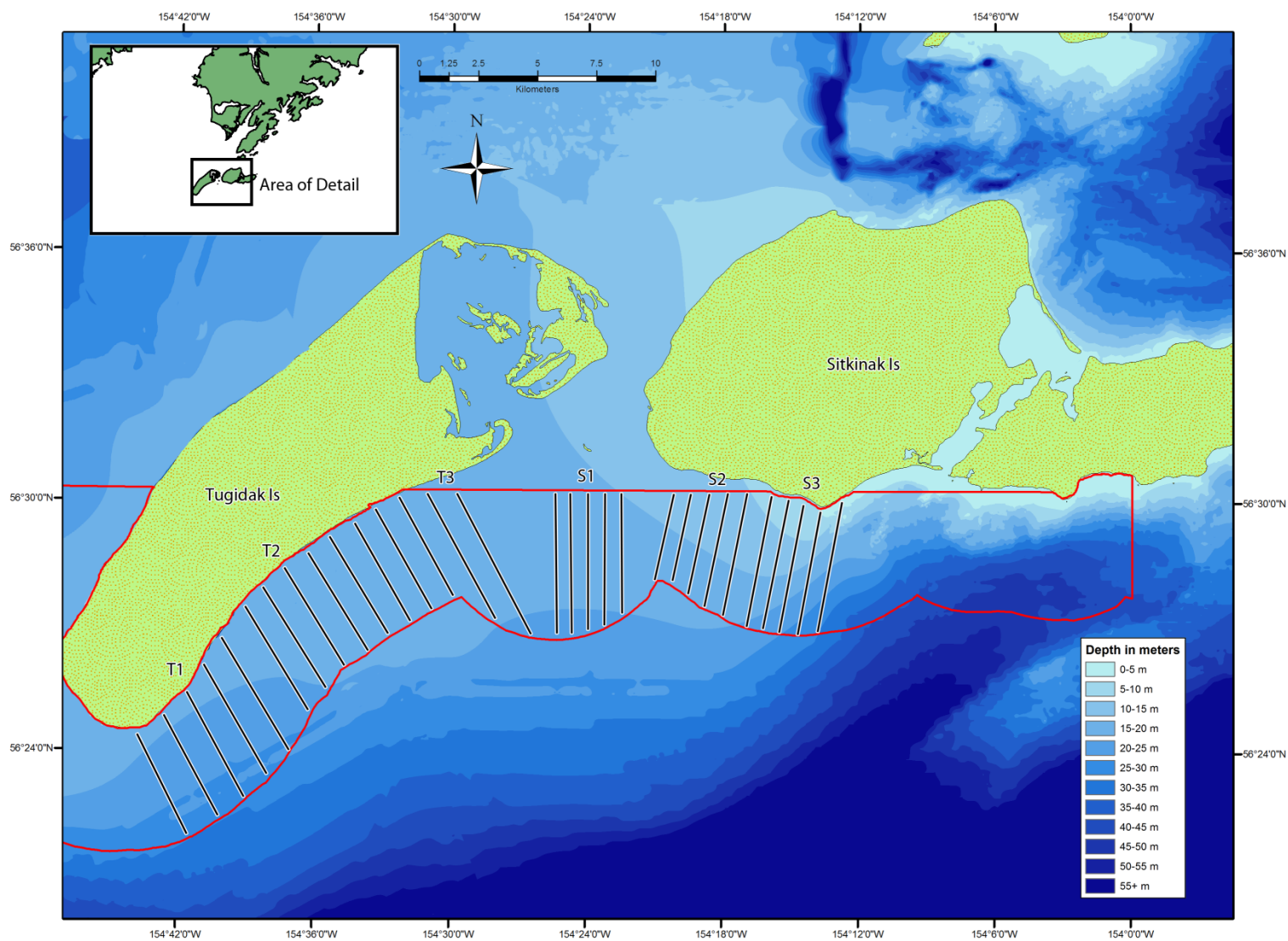


Figure 4.—Map showing six sampling locations for Dungeness crab pot surveys around Tugidak and Sitkinak islands with proposed pot transects shown (black lines), stat area 545601 (red line), and 5 m isobath intervals shown (blue stepped gradient).

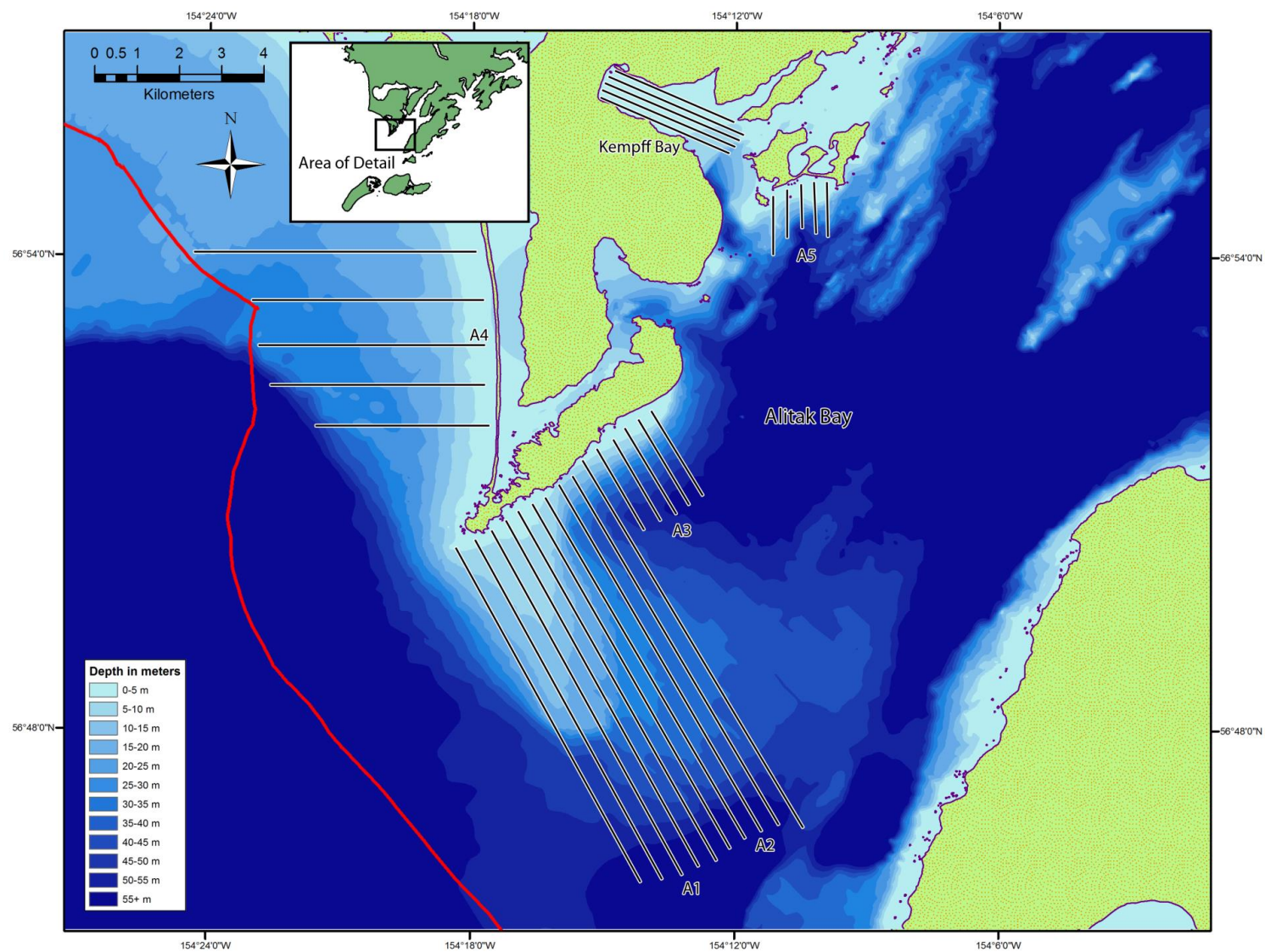


Figure 5.—Map showing four sampling locations for Dungeness crab pot surveys around lower Alitak Bay with proposed pot transects shown (black lines), stat area 545632, and 5 m isobath intervals shown (blue stepped gradient).

APPENDIX A. SURVEY SCHEDULE

Appendix A1.–August 2014 project survey schedule showing activities distinguished by color with fishing pots = Group A in yellow, Group B in orange; travel days = green; sea otter survey = blue; fishing trawl net = tan.

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
3-Aug	4-Aug	5-Aug	6-Aug	7-Aug	8-Aug	9-Aug
		Travel to Ugak Bay		Sea Otter Survey		
		Hidden Basin Pots				
			Saltery Cove Pots			
					Portage Bay Pots...	
						Eagle Harbor Pots...
10-Aug	11-Aug	12-Aug	13-Aug	14-Aug	15-Aug	16-Aug
...Portage Bay Pots			Sea Otter Survey			Travel to Tugidak Is
...Eagle Harbor Pots						Tugidak Pots T1...
Trawl Hidden Basin	Pasagshak Bay Pots					
Trawl Saltery Cove		Gull Point Pots				
			Trawl Eagle Harbor	Trawl Pasagshak Bay	Trawl Gull Point	
			Trawl Portage Bay			
17-Aug	18-Aug	19-Aug	20-Aug	21-Aug	22-Aug	23-Aug
Travel to Ugak Bay	Travel to Tugidak Is		Sea Otter Survey			
...Tugidak Pots T1				Sitkinak Pots S1...		
Retrieve Ugak Pots	Tugidak Pots T2					
		Tugidak Pots T3				
		Trawl Tugidak T1		Trawl Tugidak T2	Sitkinak Pots S2...	
						Trawl Tugidak T3
24-Aug	25-Aug	26-Aug	27-Aug	28-Aug	29-Aug	30-Aug
...Sitkinak Pots S1		Sea Otter Survey		Travel Back To Port	Travel Back To Port	
...Sitkinak Pots S2			Store Pots			
Sitkinak Pots S3						
Trawl Sitkinak S1	Store Pots		Trawl Sitkinak S3			
	Trawl Sitkinak S2					

Appendix A2.–September 2014 project survey schedule showing activities distinguished by color with fishing pots = Group A in yellow, Group B in orange; travel days = green; sea otter survey = blue; fishing trawl net = tan.

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
14-Sep	15-Sep	16-Sep	17-Sep	18-Sep	19-Sep	20-Sep
Travel to Alitak Bay	Pots from Storage		Sea Otter Survey			Trawl Kempff Bay
	Kempff Bay Pots					Trawl Alitak Bay A5
		Pots from Storage		Alitak Bay A3 Pots...		
		Alitak Bay A5 Pots				
					Alitak Flats A2 Pots...	
21-Sep	22-Sep	23-Sep	24-Sep	25-Sep	26-Sep	27-Sep
...Alitak Bay A3 Pots		Sea Otter Survey			Travel to Port	
Alitak Flats A1 Pots						
...Alitak Flats A2 Pots			Pots to Storage			
	Alitak Flats A4 Pots					
	Trawl Alitak A3		Trawl Alitak A2	Trawl Alitak A4		
				Pots to Storage		

APPENDIX B. DUNGENESS SURVEY FORMS

Vessel Captain _____

Page _____ of _____

-continued-

Vessel Name	Name of vessel used in survey.
Vessel Captain	Name of skipper running the vessel.
SPN	Sequential pot number assigned to each pot starting with 1 and continuing sequentially until the end of the survey.
Bay/Location	Name of bay or location description based on the nearest landmark.
GPS ID	A unique identification number of the GPS used to record the location of the pots. Use 2 separate GPS receivers should be used, one for deployments and one for retrievals.
Date/Time	Record date and time of each pot deployed and retrieved.
Depth	Record the depth (m) of each pot deployed and retrieved.
Waypt	Record waypoint number assigned to the location from the GPS for deployment and retrieval.
Latitude	Record latitude each pot deployed and retrieved.
Longitude	Record longitude each pot deployed and retrieved.
Datalogger ID	Record the unique datalogger ID number deployed in the pot.
Escape Rings	Record whether the escape rings are open or closed.

Appendix B2.—Skipper Trawl Record Form.



ALASKA DEPARTMENT OF FISH AND GAME 2014 TRAWL SURVEY - DUNGENESS SKIPPER TRAWL RECORD

Kurt Pedersen

Skipper's Name

Survey Area

Cruise Number		Haul Number		Region	Survey Area	Stratum	Station Number		Vessel Code	Date			
1	4	0	1						3	0	month	day	year
													1
													4

(1) Starting Position		Compass Heading (magnetic)		Trawl Time		Dist-Towed
Latitude	Longitude			Start	End	
5	1			:	:	
degrees / mins / decimal mins.		degrees / mins / decimal mins.				(nm)

(2) Haul Back Position		Elapsed (minutes)
5	1	
Position X	Position Y	

Depth (fathoms)			Weather			Line Out (fathoms)	Gear Perf.	Bottom Temp. (°C)
Maximum	Minimum	Avg.	Cloud	Wind	Swell			

Skipper's Comments (gear problems, snags, weather, tides, etc.): _____ Datalogger ID # _____

Cloud Cover	Code	Wind Speed (Beaufort Scale)	Code	Swell (feet)	Code
Clear	1	Calm ; sea surface smooth and mirror like	0	0 - 2	1
1/8 obscured	2	Light air ; scaly ripples, no foam crests	1	2 - 4	2
1/4 obscured	3	Light breeze ; small wavelets, crests glassy, not breaking	2	4 - 6	3
3/8 obscured	4	Gentle breeze ; large wavelets, crests begin to break, scattered whitecaps	3	6 - 8	4
1/2 obscured	5	Moderate breeze ; waves 1-4 ft becoming longer, numerous whitecaps	4	8 - 10	5
5/8 obscured	6	Fresh breeze ; waves 4-8 ft, longer form, many whitecaps, some spray	5	10 - 12	6
3/4 obscured	7	Strong breeze ; waves 8-13 ft, whitecaps common, more spray	6	12 - 14	7
7/8 obscured	8	Near gale ; sea heaps up, waves 13-20 ft, foam streaks off breakers	7	14 - 16	8
Completely overcast	9	Gale ; waves 13-20 ft, greater length, crest edges break, foam streaks	8	Over 16	9
		Strong gale ; waves 20 ft, sea rolls, dense foam streaks, spray	9		

Gear Performance	Code	Gear Performance	Code
Good performance	0	Unsatisfactory ; ripped net	7
Satisfactory ; unspecified minor problems	1	Unsatisfactory ; net off bottom for part/all of tow	8
Satisfactory ; minor hangup or rip	2	Unsatisfactory ; caught crab pot	9
Satisfactory ; net off bottom for short part of tow	3	Unsatisfactory ; unable to reach bottom due to currents	10
Satisfactory ; caught crab pot	4	Unsatisfactory ; net not properly configured	11
Unsatisfactory ; unspecified problem	5	Unsatisfactory ; crossed doors	12
Unsatisfactory ; net hung up	6	Unsatisfactory ; net mudded down	13

Initials: _____

-continued-

This form records each haul: area, date, position, time trawled, depth, length of tow, gear performance, and weather conditions.

Cruise Number	Last two digits of the year followed by sequential cruise number (1401 for Dungeness survey).
Haul Number	Beginning with 1, each haul is numbered sequentially through each cruise regardless of gear performance.
Region	not used
Survey area	not used
Stratum	not used
Station Number	Consult charts for station number
Vessel Code	Code for vessel conducting survey.
Date	Month/day/year.
Starting Position	<i>Latitude, Longitude</i> - degrees/minutes/decimal minutes of location where the net reaches bottom
Compass Heading	Direction of tow according to magnetic compass
Trawl time	<i>Start</i> - Time net reaches bottom, use 24 hour clock <i>End</i> - Time net retrieval begins, use 24 hour clock
Dist- Towed	Length of the haul in nautical miles, determined by skipper
Haul Back Position	<i>Latitude, Longitude</i> - degrees/minutes/decimal minutes of location where net retrieval begins
Elapsed	Amount of time in minutes when net was fishing
Depth	<i>Maximum</i> - Maximum depth of haul in fathoms <i>Minimum Depth</i> - Minimum depth of haul in fathoms <i>Avg. Depth</i> - Average depth of haul in fathoms, determined by skipper
Weather	<i>Cloud, Wind, Swell</i> - use criteria on data sheet
Scope	Fathoms of cable deployed
Gear Performance	Use Gear Performance codes on data sheet. Written explanation should accompany problem tows.
Bottom Temperature	Recorded in database upon download of temperature logger data attached to net. Record temperature if available.
Datalogger ID #	Record the datalogger ID number each time the datalogger is deployed on the trawl net.
Initials	Record initials of person entering data into the haul database.

ADF&G CRAB DATA FORM

Page ____ of ____

SPECIES _____
 SEX _____
 VESSEL _____
 DATE

	-	-	-	-	
--	---	---	---	---	--

STATION NUMBER
 POT ORDER
 BUOY NUMBER
 TRAWL HAUL NUMBER
 SAMPLING FACTOR

S P E C I E S	S E X C O D E	CARAPACE LENGTH (MM)	CARAPACE WIDTH (MM)	C O N D I T I O N	D I S E A S E C O D E	EGGS			T A G N U M B E R	COMMENTS
						% CLUTCH FULLNESS	D E V E L O P M E N T	C O N D I T I O N		
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										
25										

CODE INSTRUCTIONS**SPECIES**1. *L. AEQUISPINA*2. *P. CAMTSCHATICA*3. *P. PLATYPUS*6. *C. BAIRDI*7. *C. OPILIO*9. *C. MAGISTER***SEX CODE**

1. Sublegal Male

2. Legal Male

3. Juvenile Female

4. Adult Female

SHELL CONDITION

0. Soft

1. New

2. Old

3. Very Old

DISEASE CODE

1. Black Mat

2. Bitter Crab Syndrome

3. Nemertean Worms

4. Parasitic barnacle

EGG DEVELOPMENT

1. Uneyed eggs

2. Eyed eggs

CLUTCH CONDITION

1. Dead Eggs Not Apparent

2. Dead Eggs < 20%

3. Dead Eggs > 20%

4. Barren with Clean "Silky" Setae

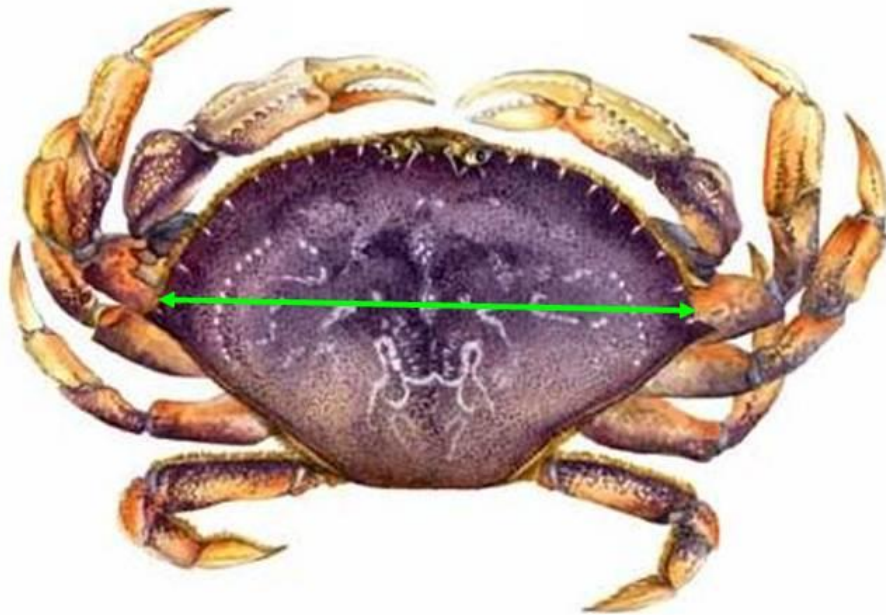
5. Barren with "Matted" setae, Empty
empty Egg Cases

-continued-

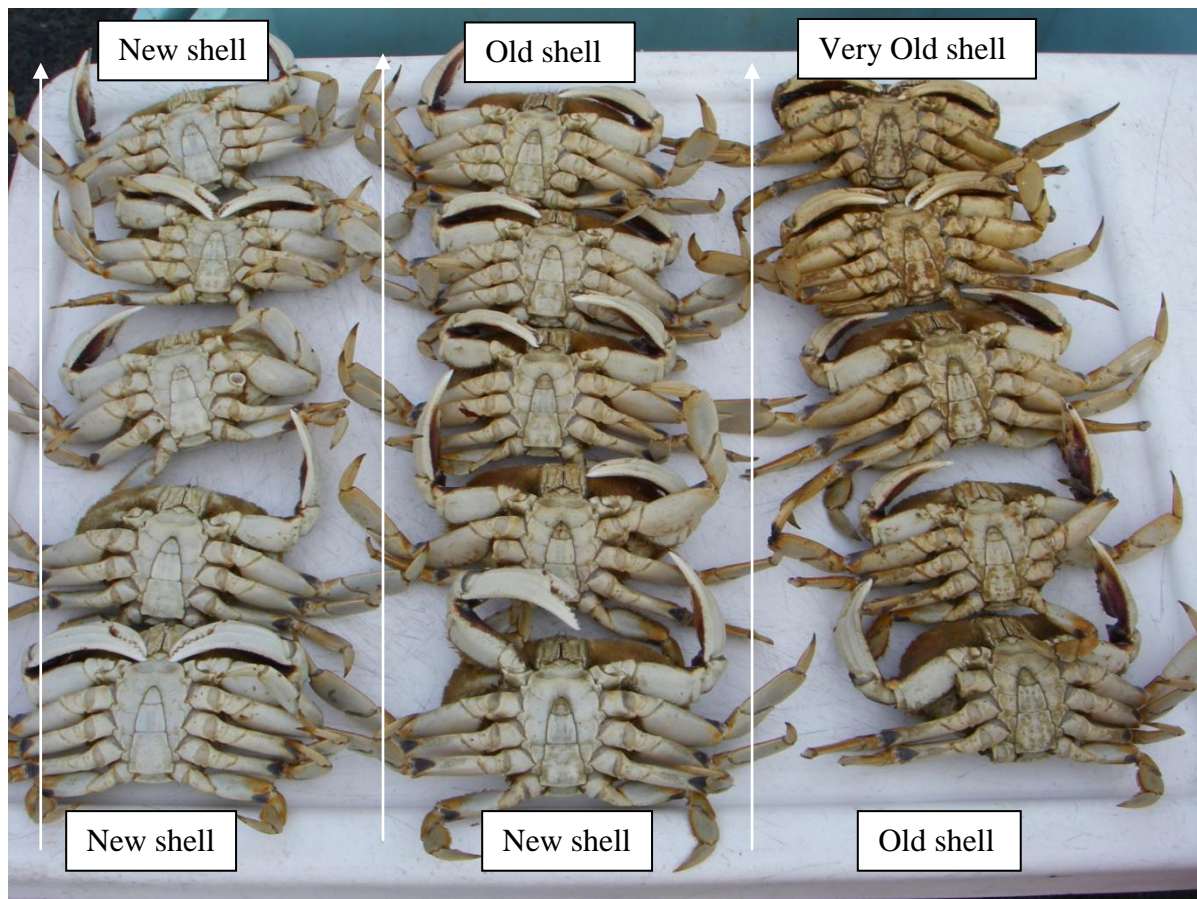
Species and Sex	Common name or scientific name of crab listed in the first column of the form. (only one species per form). Male or Female (only one per form).
Vessel	Name and/or number of vessel conducting survey
Date	Month, day and year on which information is collected and recorded.
Station Number	Number assigned to specific location of trawl.
Pot order	For pot surveys only—not used on trawl survey.
Buoy Number	Number of buoy—pot surveys only, not used for trawl survey.
Trawl haul number	Numerical sequence of hauls.
Sampling Factor	Used to indicate the ratio of samples to entire catch. A '1/1' entry would indicate all crab caught were measured a '1/10' entry would indicate that one crab was measured for every ten crabs caught of the same species, sex, and shell age.
Species	Use codes listed on bottom of form, the numerical code must Match code to the written species name indicated at the top of the form.
Sex and Legal size	Codes are listed at bottom of form. The numerical code represents sex and legal size.
Carapace length	Indicate to nearest millimeter.
Carapace width	Indicate to nearest millimeter.
Shell condition	Codes are listed at the bottom of the form: 0, soft Crab 0-2 months since molt. 1, new Crab 3-12 months since molt. 2, old Crab 13-24 months since molt. 3, very old Crab 25 plus months since molt.
Disease code	Codes are listed at the bottom of the form. Potential diseases or parasites not listed should be noted in the comment section.
Eggs % clutch	The percent of egg fullness of the clutch, as estimated by measurer. Use increments of 10s.
Development	Codes are listed at the bottom of form for (2) eyed and (1) uneyed eggs.
Clutch condition	Codes are listed at the bottom of the form for (1) no dead eggs, (2) dead <20%, (3) dead >20%, (4) silky, (5) matted.
Tag Number	Number of tag. Use when tagging crab.
Comments	For notation of anything anomalous on individual crab such as parasites, morbidity, etc.

APPENDIX C. SAMPLING AND TAGGING PROCEDURES

DUNGENESS CRAB



Carapace width (biological and legal): The straight-line distance across the carapace immediately anterior to the tenth anterolateral spine and *shall not include the spines*.



Dungeness Crab Clutch Fullness



no eggs, matted

no eggs, clean



1/2 full



3/4 full



full

Note: Not all clutch fullnesses are shown here

Appendix C4.–Dungeness crab tag location.

Tags will be inserted at the posterior margin of the epimeral suture immediately posterior of the third walking leg.



APPENDIX D. SEA OTTER SURVEY FORM AND PROCEDURES

Appendix D1.–Sea otter observation form.

Sea Otter Observation Form											Page: _____ of _____
Date: _____		Area/Bay: _____		Start Time: _____		End Time: _____		Observer(s): _____			
Weather: _____			Sea State: _____			Tide: _____		Wind Speed: _____			
Wind Direction: _____			Visibility: _____			Water Temperature: _____					
Activity	Area Radius Monitored	Otters Seen Y/N	Latitude	Longitude	Number of Sea Otters	Group Size	Adult/Pup Count	Time Observed	Human Disturbance	Response Behavior	Comments ¹
Dropping pots											
Pulling pots											
Area Observations											
Beach Survey											

Weather

0 = <50% clouds
1 = >50% clouds
2 = patchy fog
3 = rain
4 = fog and drizzle
5 = drizzle/mist
6 = snow
7 = fog and rain
8 = hail

Tide

1 = High tide
2 = 3/4 outgoing direction
3 = 1/2 outgoing direction
4 = 1/4 outgoing direction
5 = low tide
6 = 1/4 incoming direction
7 = 1/2 incoming direction
8 = 3/4 incoming direction

Wind Direction

N = north, etc.
NE = northeast, etc.
V = variable
0 = none

Group size

No. per group
No. single otters

Adult

1/1 = adults/pups

Human Disturbance

0 = No disturbance
1 = Slight disturbance
2 = Moderate disturbance
3 = Severe disturbance

Sea States

0 = calm
1 = ripples
2 = small wavelets
3 = large wavelets

4 = small wave 0.5 to 1.25 m high, numerous whitecaps
5 = moderate waves of 1.25 to 2.5 m; many whitecaps; some spray
6 = larger waves 2.5 to 4 m forming; whitecaps everywhere; more spray
7 = sea heaps up, waves 4 to 6 m; white foam from breaking waves begins to be blown in streaks

Response Behavior

1 = avoidance
2 = attracted
3 = diving near gear
4 = interest in gear

5 = vocalizations
6 = grooming
7 = feeding
8 = diving avoidance

9 = mother/pup interactions
10 = adult interactions

¹ Note sea otter sightings where animals are hauled out on land or intertidal rocks.

-continued-

Date	Month, day, year of sea otter observation event.
Area/Bay	Name the location by area or bay name.
Start Time	Hour, minute of start of observation event.
Stop Time	Hour, minute of when stop observing.
Observers	List names of observers conducting the survey.
Weather	Description of weather. Use codes at bottom of form.
Sea State	Height of seas when observations were taken. Use codes at bottom of form.
Tide	Tide stage. Use codes at bottom of form.
Wind Speed	Wind speed in knots.
Wind Direction	Wind direction, north = N, northeast = NE, etc.
Visibility	Visibility distance up to 1,000 m.
Water Temperature	Surface water temperature in °C.
Activity	Record data under appropriate activity.
Area Radius Monitored	Distance from vessel to area surveyed.
Otters Seen Y/N	Record presence of sea otters, Y = yes, N = No.
Latitude	Location starting point of survey in decimal degrees.
Longitude	Location starting point of survey, in decimal degrees.
Number of Sea Otters	Count the total number of sea otters observed.
Group size	Record the number of otters in each group and number of single otters (e.g. 1 group of 20 otters, 1-20; two groups of 10 otters, 2-10; 4 single otters, 4-1).
Adult/Pup Count	Record Adult/Pup ratio (e.g. 3 females/2 pups, 3/2).
Time Observed	Total time of the observation.
Human Disturbance	Reaction of sea otters to human presence. Slight disturbance - looking over at vessel; Severe disturbance - diving out of sight. Use codes at bottom of form.
Response Behavior	General sea otter behavior. Use multiple codes at bottom of form.
Comments	Record injuries, mortalities, anything of interest. Note sea otter sightings where animals are hauled out on land or on intertidal rocks.

Appendix D2.–Sea otter behavior and sex determination.

It may be difficult to determine the sex of the otter if the reproductive organs are not obvious. Sea otters often rest together in single-sex groups called rafts. With the exception of territorial males, males and females tend to live in separate groups until mating. Pups reside exclusively with females. Males tend to remain in the same general location, moving only a mile or two along the coastline. Females, on the other hand, are less sedentary by nature, generally staying within 10 – 20 miles of their home ranges. Once we have categorized the various groups, we will determine which sex group we are observing. Using binoculars, we will examine the sizes of the otters in each group. Generally, females are smaller, on average measuring 3 inches shorter than males, and tend to be approximately 30 pounds lighter. Females sometimes have pink scars on their nose from the males grasping during copulation and males will be pursuing females during mating season (autumn).

We will record all sea otter behaviors and the total time observed. Sea otters are equally active both night and day. A foraging bout occurs for several hours in the morning, typically starting just before sunrise and a second foraging bout begins in the afternoon, usually lasting for several hours until sunset. Grooming occurs before and after each foraging bout and resting occurs midday, followed again by another grooming and resting bout. A third foraging bout may also occur around midnight. Although difficult to hear from shore, sea otters exhibit a variety of vocal behaviors. Pups are the most vocal and can be heard squealing (similar to a gull) when its mother leaves it to dive for food and often times when a male approaches. Other vocalizations include: coos and grunts, which occur when an animal is eating or when content, as in the case of a pair-bonded couple during courtship; whines which occur when an animal is frustrated, as in the case of an older pup wanting to suckle or an adult male attempting to mate with an uninterested female; growls, snarls, whistles and hisses can be heard when an animal is frightened or distressed, as in the case of a captured otter. For more information on sea otters see <http://seaotters.com/sea-otters/>.

Note any human disturbance during the observations. A slight disturbance may range from the otter stops and looks in your direction, to a severe disturbance like diving or swimming away from vessel. Record anything else of interest such as injuries, mortalities, other unique behaviors and note whether sea otters are hauled out on land or on intertidal rocks.